

Application No. 09/893,315
Amendment dated
Reply to Office Action of September 9, 2005

Docket No.: 291958161US

AMENDMENTS TO THE CLAIMS

1-53. (Cancelled)

54. (Previously Presented) An apparatus for processing a single wafer, such as a semiconductor wafer, a magnetic disk, or an optical disk, comprising:

- a framework;
- a processing bowl mounted to the framework, the processing bowl comprising an inner portion having an interior adapted to receive a pool of a processing chemical, an outer portion, and a fluid-receiving space between the inner portion and the outer portion;
- a chemical supply adapted to supply the processing chemical to the processing bowl;
- a processor head mounted for movement between at least one loading position and at least one processing position, the processor head in its loading position being adapted to position a wafer outside the interior of the inner portion, the processor head carrying a rotatable wafer support adapted to support a wafer within the interior of the inner portion when the processor head is in the processing position, wherein a portion of the head extends radially outward over and along an upper edge of the bowl;
- a second processing chamber; and
- a wafer transfer adapted to move wafers to and from the processing bowl, and to and from the second processing chamber.

55. (Previously Presented) An apparatus according to claim 54 wherein the wafer support extends downwardly to a height below an upper edge of the processing bowl when the processor head is in the processing position.

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56. (Previously Presented) An apparatus according to claim 54 wherein the wafer support is positioned to support wafers at a height below an upper edge of the processing bowl.

57. (Previously Presented) An apparatus according to claim 54 further comprising a drain in fluid communication with the fluid-receiving space of the processing bowl.

58. (Previously Presented) An apparatus according to claim 54 wherein the processing bowl includes a fluid line in fluid communication with the fluid-receiving space of the processing bowl.

59. (Previously Presented) An apparatus according to claim 58 wherein the fluid line directs fluid from the fluid-receiving space to a disposal line.

60-64. (Cancelled)

65. (Previously Presented) An apparatus according to claim 54 wherein the processor head is adapted to move vertically downwardly toward the pool of the processing chemical in moving from its loading position to its processing position.

66. (Previously Presented) An apparatus according to claim 65 wherein the processor head is adapted to move vertically upwardly away from the pool of the processing chemical in moving from its processing position to its loading position.

67-68. (Cancelled)

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69. (Currently Amended) An apparatus according to claim ~~68-54~~ wherein the water support is configured to rotate at a first rotational speed is of 50-250 rpm and the a second rotational speed is selected to spin dry a surface of the wafer.

70. (Currently Amended) An apparatus according to claim ~~68-69~~ wherein ~~the first rotational speed is 50-250 rpm and the~~ second rotational speed is at least 1000 rpm.

71. (Previously Presented) An apparatus according to claim 54 wherein the processor head comprises an annular gas-receiving recess having a height above a height of a front surface of any wafer carried by the wafer support when the processor head is in the processing position.

72. (Previously Presented) An apparatus according to claim 54 wherein the wafer support comprises a wafer support plate having a downwardly directed front face and an upwardly directed back face.

73. (Previously Presented) An apparatus according to claim 72 wherein the wafer support further comprises a plurality of fingers adapted to engage a peripheral edge of a wafer.

74. (Previously Presented) The wafer processor of claim 73 wherein the fingers peripherally support the wafer.

75. (Previously Presented) An apparatus according to claim 54 wherein the processing bowl is adapted to retain an acidic processing chemical.

76. (Previously Presented) An apparatus according to claim 54 wherein at least a portion of the processing bowl is formed of an acid-resistant plastic.

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77. (Previously Presented) An apparatus according to claim 76 wherein the inner portion of the processing bowl is formed of the acid-resistant plastic.

78. (Previously Presented) An apparatus according to claim 77 further comprising a drain in fluid communication with the fluid-receiving space.

79. (Previously Presented) An apparatus according to claim 54 wherein the second processing chamber is adapted to heat a wafer placed therein.

80. (Previously Presented) An apparatus according to claim 79 wherein the second processing chamber comprises a heat source and a platform positioned to support wafers within the second processing chamber.

81. (Previously Presented) An apparatus according to claim 80 wherein a height of the platform within the second processing chamber is adjustable.

82. (Previously Presented) An apparatus according to claim 81 wherein the platform supports wafer support stands positioned to supportively contact a back side of a wafer.

83. (Previously Presented) An apparatus according to claim 82 wherein the wafer support stands are positioned within a wafer protection vessel which is supported upon the platform.

84. (Cancelled)

85. (Previously Presented) An apparatus for processing a single wafer, such as a semiconductor wafer, a magnetic disk, or an optical disk, comprising:
a framework;

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- a processing bowl mounted to the framework, the processing bowl comprising an upper edge, an inner portion adapted to receive a pool of a processing chemical, an outer portion, and a fluid-receiving space between the inner portion and the outer portion;
- a chemical supply adapted to supply the processing chemical to the processing bowl;
- a processor head mounted for movement between at least one loading position and at least one processing position, the processor head in its loading position being adapted to position wafers above the processing bowl, the processor head carrying a rotatable wafer support adapted to position a wafer below the upper edge of the processing bowl when the processor head is in the processing position, wherein the wafer support is configured to overlay a single wafer and support a periphery of the single wafer with a process side of the wafer facing downward;
- a second processing chamber; and
- a wafer transfer adapted to move wafers to and from the processing bowl, and to and from the second processing chamber.

86. (Previously Presented) An apparatus according to claim 85 further comprising a drain in fluid communication with the fluid-receiving space of the processing bowl.

87. (Previously Presented) An apparatus according to claim 85 wherein the processing bowl includes a fluid line in fluid communication with the fluid-receiving space of the processing bowl.

88-93. (Cancelled)

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94. (Previously Presented) An apparatus according to claim 85 wherein the processor head is adapted to move vertically downwardly toward the pool of the processing chemical in moving from its loading position to its processing position.

95. (Previously Presented) An apparatus according to claim 94 wherein the processor head is adapted to move vertically upwardly away from the pool of the processing chemical in moving from its processing position to its loading position.

96. (Previously Presented) An apparatus according to claim 85 wherein the processor head carries a motor operatively connected to the wafer support and adapted to rotate the wafer support.

97. (Previously Presented) An apparatus according to claim 96 wherein the motor is adapted to rotate the wafer support at a first rotational speed during processing of a wafer by the processing chemical and at a higher second rotational speed thereafter.

98. (Previously Presented) An apparatus according to claim 97 wherein the first rotational speed is 50-250 rpm and the second rotational speed is selected to spin dry a surface of the wafer.

99. (Previously Presented) An apparatus according to claim 97 wherein the first rotational speed is 50-250 rpm and the second rotational speed is at least 1000 rpm.

100. (Previously Presented) An apparatus according to claim 85 wherein the processor head comprises an annular gas-receiving recess having a height above a height of a front surface of any wafer carried by the wafer support when the processor head is in the processing position.

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101. (Previously Presented) An apparatus according to claim 85 wherein the wafer support comprises a wafer support plate having a downwardly directed front face and an upwardly directed back face.

102. (Previously Presented) An apparatus according to claim 101 wherein the wafer support further comprises a plurality of fingers adapted to engage a peripheral edge of a wafer.

103. (Previously Presented) The wafer processor of claim 102 wherein the fingers peripherally support the wafer.

104. (Previously Presented) An apparatus according to claim 85 wherein the processing bowl is adapted to retain an acidic processing chemical.

105. (Previously Presented) An apparatus according to claim 85 wherein at least a portion of the processing bowl is formed of an acid-resistant plastic.

106. (Previously Presented) An apparatus according to claim 105 wherein the inner portion of the processing bowl is formed of the acid-resistant plastic.

107. (Previously Presented) An apparatus according to claim 106 further comprising a drain in fluid communication with the fluid-receiving space.

108. (Previously Presented) An apparatus according to claim 85 wherein the second processing chamber is adapted to heat a wafer placed therein.

109. (Previously Presented) An apparatus according to claim 108 wherein the second processing chamber comprises a heat source and a platform positioned to support wafers within the second processing chamber.

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110. (Previously Presented) An apparatus according to claim 109 wherein a height of the platform within the second processing chamber is adjustable.

111. (Previously Presented) An apparatus according to claim 110 wherein the platform supports wafer support stands positioned to supportively contact a back side of a wafer.

112. (Previously Presented) An apparatus according to claim 111 wherein the wafer support stands are positioned within a wafer protection vessel which is supported upon the platform.

113. (Previously Presented) An apparatus according to claim 109 wherein the heat source comprises an infrared lamp.

114. (Cancelled)

115. (Previously Presented) An apparatus for processing a single wafer, such as a semiconductor wafer, a magnetic disk, or an optical disk, comprising:

a framework;

a processing bowl mounted to the framework and including an upper edge;

a chemical supply adapted to supply a processing chemical to the processing bowl;

a processor head mounted for movement between at least one loading position and

at least one processing position, the processor head in its loading position being adapted to position a wafer higher than the upper edge of the processing bowl for loading or unloading a wafer from the processor head, the processor head carrying a rotatable wafer support and a motor, the wafer support being adapted to support a wafer below the upper edge of the processing bowl when the processor head is in its processing position, the motor being positioned above the wafer support and adapted to rotate the

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wafer support and any wafer held therein, wherein the wafer support is configured to overlay a single wafer and support a periphery of the single wafer with a process side of the wafer facing downward;
a second processing chamber; and
a wafer transfer adapted to move wafers to and from the processing bowl, and to and from the second processing chamber.

116. (Previously Presented) An apparatus according to claim 115 wherein the processing bowl is adapted to receive a pool of the processing chemical.

117. (Previously Presented) An apparatus according to claim 116 wherein the wafer support extends downwardly into an interior of the processing bowl when the processor head is in the processing position.

118. (Previously Presented) An apparatus according to claim 116 wherein the processor head is adapted to move vertically downwardly toward the pool of the processing chemical in moving from its loading position to its processing position.

119. (Previously Presented) An apparatus according to claim 118 wherein the processor head is adapted to move vertically upwardly away from the pool of the processing chemical in moving from its processing position to its loading position.

120. (Previously Presented) An apparatus according to claim 115 wherein the motor is adapted to rotate the wafer support at a first rotational speed during processing of a wafer by the processing chemical and at a higher second rotational speed thereafter.

121-122. (Cancelled)

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123. (Previously Presented) An apparatus according to claim 115 wherein the processor head comprises an annular gas-receiving recess having a height above a height of a front surface of any wafer carried by the wafer support when the processor head is in the processing position.

124. (Previously Presented) An apparatus according to claim 115 wherein the processing bowl comprises an outer portion and an inner portion, the inner portion being adapted to receive a pool of the processing chemical therein.

125. (Previously Presented) An apparatus according to claim 124 further comprising a drain in fluid communication with a space between the inner and outer portions.

126. (Previously Presented) An apparatus for processing wafers, such as semiconductor wafers, magnetic disks, and optical disks, comprising:

a framework;

a processing bowl mounted to the framework;

a chemical supply adapted to supply a processing chemical to the processing bowl;

a processor head mounted for movement between at least one loading position and

at least one processing position, the processor head in its loading position being adapted to load or unload a wafer from the processor head, the processor head comprising a rotatable wafer support and an annular gas-receiving recess, the wafer support being adapted to position a wafer for processing with the processing chemical when the processor head is in the processing position, the gas-receiving recess extending higher than a front surface of any wafer carried by the wafer support when the processor head is in the processing positions, wherein the wafer support is configured to overlay a single wafer and support a periphery of the single wafer with a process side of the wafer facing downward;

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a second processing chamber; and
a wafer transfer adapted to move wafers to and from the processing bowl, and to
and from the second processing chamber.

127. (Previously Presented) An apparatus according to claim 126 further comprising a motor carried by the processor head, the motor being operatively connected to the wafer support and adapted to rotate the wafer support.

128. (Previously Presented) An apparatus according to claim 127 wherein the motor is adapted to rotate the wafer support at a first rotational speed during processing of a wafer by the processing chemical and at a higher second rotational speed thereafter.

129-130. (Cancelled)

131. (Previously Presented) An apparatus according to claim 126 wherein the wafer support extends downwardly to a height below an upper edge of the processing bowl when the processor head is in its processing position.

132. (Previously Presented) An apparatus according to claim 126 wherein the wafer support is positioned to support wafers at a height below an upper edge of the processing bowl.

133. (Previously Presented) An apparatus according to claim 126 wherein the processing bowl includes a drain and a fluid line, the drain being adapted to direct overflow of the processing chemical into the fluid line.

134. (Previously Presented) An apparatus according to claim 133 wherein the processing bowl comprises an inner portion and an outer portion, the drain being in fluid communication with a space between the inner and outer portions.

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135. (Previously Presented) An apparatus according to claim 133 wherein the fluid line directs fluid from the drain to a disposal line.

136-137. (Cancelled)

138. (Previously Presented) An apparatus according to claim 126 wherein the processor head is adapted to move vertically downwardly toward the processing bowl in moving from its loading position to its processing position.

139. (Previously Presented) An apparatus according to claim 138 wherein the processor head is adapted to move vertically upwardly away from the processing bowl in moving from its processing position to its loading position.

140. (Previously Presented) An apparatus according to claim 126 wherein at least a portion of the processing bowl is formed of an acid-resistant plastic.

141. (Previously Presented) An apparatus according to claim 140 wherein the processing bowl comprises an inner portion and an outer portion, the inner portion being formed of the acid-resistant plastic.

142. (Previously Presented) An apparatus according to claim 141 wherein the inner portion is adapted to receive a pool of the processing chemical therein.

143. (Previously Presented) An apparatus according to claim 141 further comprising a drain in fluid communication with a space between the inner portion and the outer portion.

144. (Previously Presented) An apparatus according to claim 126 wherein the second processing chamber is adapted to heat wafers placed therein.

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145. (Previously Presented) An apparatus according to claim 144 wherein the second processing chamber comprises a heat source and a platform positioned to support wafers within the second processing chamber.

146. (Previously Presented) An apparatus according to claim 145 wherein a height of the platform within the second processing chamber is adjustable.

147. (Previously Presented) An apparatus according to claim 146 wherein the platform supports wafer support stands positioned to supportively contact a back side of a wafer.

148. (Previously Presented) An apparatus according to claim 147 wherein the wafer support stands are positioned within a wafer protection vessel which is supported upon the platform.

149. (Cancelled)

150. (Previously Presented) An apparatus for processing wafers, such as semiconductor wafers, magnetic disks, and optical disks, comprising:

a framework;

a processing bowl mounted to the framework, the processing bowl comprising an upper edge, an inner portion adapted to receive a pool of a processing chemical, an outer portion, a fluid-receiving space between the inner portion and the outer portion, and a drain in fluid communication with the fluid-receiving space;

a processor head comprising a wafer support adapted to support a wafer about the periphery of the wafer, the processor head extending outwardly of the periphery of any wafer held in the wafer support, the processor head being moveable between at least one loading position and at least one processing

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position, the processor head in its loading position being adapted to position the wafer support higher than the upper edge of the processing bowl for loading or unloading a wafer, the wafer support being adapted to position a wafer below the upper edge of the processing bowl when the processor head is in its processing position, wherein a portion of the processor head extends radially outward over and along the upper edge of the bowl; and a motor carried by the processor head and operatively coupled to the wafer support to rotate the wafer support.

151. (Previously Presented) An apparatus according to claim 150 wherein the processing bowl is adapted to retain an acidic processing chemical.

152. (Previously Presented) An apparatus according to claim 151 wherein the inner portion of the processing bowl is formed of an acid-resistant plastic.

153. (Previously Presented) An apparatus according to claim 150 wherein the wafer support extends downwardly to a height below an upper edge of the processing bowl when the processor head is in the processing position.

154. (Previously Presented) An apparatus according to claim 150 wherein the wafer support is positioned to support wafers at a height below an upper edge of the processing bowl.

155. (Previously Presented) An apparatus according to claim 150 further comprising a fluid line adapted to direct fluid from the drain to a disposal line.

156-157. (Cancelled)

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158. (Previously Presented) An apparatus according to claim 150 wherein the processor head is adapted to move vertically downwardly toward the pool of the processing chemical in moving from its loading position to its processing position.

159. (Previously Presented) An apparatus according to claim 158 wherein the processor head is adapted to move vertically upwardly away from the pool of the processing chemical in moving from its processing position to its loading position.

160. (Previously Presented) An apparatus according to claim 150 wherein the second processing chamber is adapted to heat a wafer placed therein.

161. (Previously Presented) An apparatus for processing a single wafer, such as a semiconductor wafer, a magnetic disk, or an optical disk, comprising:

- a framework;

- a processing bowl mounted to the framework, the processing bowl comprising an inner portion adapted to receive a pool of a processing chemical, an outer portion, and a fluid-receiving space between the inner portion and the outer portion;

- a chemical supply adapted to supply the processing chemical to the processing bowl;

- a processor head mounted for movement between at least one loading position and at least one processing position, the processor head in its loading position being adapted to position wafers above the processing bowl, the processor head carrying a rotatable wafer support adapted to position a wafer below an upper inlet of the fluid-receiving space when the processor head is in the processing position, wherein the wafer support is configured to overlay a single wafer and support a periphery of the single wafer with a process side of the wafer facing downward;

- a second processing chamber; and

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a wafer transfer adapted to move wafers to and from the processing bowl, and to and from the second processing chamber.

162. (Previously Presented) An apparatus according to claim 161 further comprising a drain in fluid communication with the fluid-receiving space of the processing bowl.

163. (Previously Presented) An apparatus according to claim 161 wherein the processing bowl includes a fluid line in fluid communication with the fluid-receiving space of the processing bowl.

164. (Previously Presented) An apparatus according to claim 163 further comprising a fluid line adapted to direct fluid from the drain to a disposal line.

165-169. (Cancelled)

170. (Previously Presented) An apparatus according to claim 161 wherein the processor head is adapted to move vertically downwardly toward the pool of the processing chemical in moving from its loading position to its processing position.

171. (Previously Presented) An apparatus according to claim 170 wherein the processor head is adapted to move vertically upwardly away from the pool of the processing chemical in moving from its processing position to its loading position.

172. (Previously Presented) An apparatus according to claim 161 wherein the processor head carries a motor operatively connected to the wafer support and adapted to rotate the wafer support.

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173. (Previously Presented) An apparatus according to claim 172 wherein the motor is adapted to rotate the wafer support at a first rotational speed during processing of a wafer by the processing chemical and at a higher second rotational speed thereafter.

174-175. (Cancelled)

176. (Previously Presented) An apparatus according to claim 161 wherein the processor head comprises an annular gas-receiving recess having a height above a height of a front surface of any wafer carried by the wafer support when the processor head is in the processing position.

177. (Previously Presented) An apparatus according to claim 161 wherein the wafer support comprises a wafer support plate having a downwardly directed front face and an upwardly directed back face.

178. (Previously Presented) An apparatus according to claim 177 wherein the wafer support further comprises a plurality of fingers adapted to engage a peripheral edge of a wafer.

179. (Previously Presented) The wafer processor of claim 178 wherein the fingers peripherally support the wafer.

180. (Previously Presented) An apparatus according to claim 161 wherein the processing bowl is adapted to retain an acidic processing chemical.

181. (Previously Presented) An apparatus according to claim 161 wherein at least a portion of the processing bowl is formed of an acid-resistant plastic.

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182. (Previously Presented) An apparatus according to claim 181 wherein the inner portion of the processing bowl is formed of the acid-resistant plastic.

183. (Previously Presented) An apparatus according to claim 182 further comprising a drain in fluid communication with the fluid-receiving space.

184. (Previously Presented) An apparatus according to claim 161 wherein the second processing chamber is adapted to heat a wafer placed therein.

185. (Previously Presented) An apparatus according to claim 184 wherein the second processing chamber comprises a heat source and a platform positioned to support wafers within the second processing chamber.

186. (Previously Presented) An apparatus according to claim 185 wherein a height of the platform within the second processing chamber is adjustable.

187. (Previously Presented) An apparatus according to claim 186 wherein the platform supports wafer support stands positioned to supportively contact a back side of a wafer.

188. (Previously Presented) An apparatus according to claim 187 wherein the wafer support stands are positioned within a wafer protection vessel which is supported upon the platform.

189. (Previously Presented) An apparatus according to claim 185 wherein the heat source comprises an infrared lamp.

190. (Cancelled)

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191. (Previously Presented) A method of treating a wafer, comprising:
positioning a processor head in a loading position, the processor head comprising a wafer support;
peripherally supporting a single wafer with the wafer support;
lowering the processor head into a processing position wherein the wafer is positioned in an interior of a processing bowl, the processing bowl comprising an inner portion, an outer portion, and a fluid-receiving space between the inner portion and the outer portion, and wherein the wafer support is configured to overlay a single wafer and support a periphery of the single wafer with a process side of the wafer facing downward;
supplying a processing chemical from a chemical supply to the interior of the processing bowl;
lifting the processor head to position the wafer outside the interior of the processing bowl;
engaging the wafer with a wafer transfer and transferring the wafer from the processing head to a second processing chamber.

192-195. (Cancelled)

196. (Previously Presented) An apparatus for treating a wafer, comprising:
a processor head comprising a wafer support;
a processing bowl comprising an inner portion, an outer portion, and a fluid-receiving space between the inner portion and the outer portion;
means for positioning a processor head in a loading position;
means for peripherally supporting a single wafer with the wafer support;
means for lowering the processor head into a processing position wherein the wafer is positioned in an interior of a processing bowl and a portion of the processing head extends radially outward over and along an upper edge of the processing bowl;

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means for supplying a processing chemical from a chemical supply to the interior of the processing bowl;
means for lifting the processor head to position the wafer outside the interior of the processing bowl;
means for engaging the wafer with a wafer transfer; and
means for transferring the wafer from the processing head to a second processing chamber.

197. (Previously Presented) The wafer processor of claim 115, further comprising:

a spray processing vessel defined at least in part by the processing bowl;
a spray-head mounted within the spray processing vessel for directing a spray of coating upon a single wafer being held face down by the wafer holder, the spray-head being moveable relative to the spray processing vessel and relative to the wafer holder to allow the spray-head to be directed to different areas of the wafer;
a gas conduit for delivering a carrier gas to the spray-head;
a coating conduit for delivering a coating material to the spray-head;
a coating metering pump for delivering a precise quantity of the coating material to the spray head; and
a coating viscosity control for controlling viscosity of the coating material applied by the spray-head.

198. (Previously Presented) The wafer processor of claim 115 wherein the processor head further comprises a wafer plate that overlays the wafer and a circular shroud over the motor.

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199. (Previously Presented) The wafer processor of claim 115, further comprising:

gripping fingers arranged to engage the periphery of the wafer; and

actuator means to pivotally move the gripping fingers to engage/disengage the periphery of the wafer.

200. (Previously Presented) The wafer processor of claim 199 further comprising flexible support diaphragms sealingly engaged with corresponding gripping fingers.